OpenAirInterface

Improvement of software quality

7th Nov. 2017

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Agenda

- Software Quality and Carrier Grade
- Approach to OAI quality improvement
- Extra
Software Quality and Carrier Grade

Maintainability
- Analyzability
- Changeability
- Testability
- Stability

Usability
- Attractiveness
- Understandability
- Operability
- Learnability

Functionality
- Suitability
- Interoperability
- Regularity
- Accuracy
- Security

Reliability
- Fault Tolerance
- Recoverability
- Maturity

Efficiency
- Resource Utilization
- Time Behavior

Portability
- Adaptability
- Replaceability
- Installability
- Co-existence

Software Quality
ISO 9126

Carrier Grade

1. Extreme Stability
   No system/process/thread down. 24hrs/7days running.

2. Extreme Fault Tolerance
   Expect and get ready for unexpected things.

3. Extreme Recoverability
   Restart services immediately even after any fault occurs.

Well Tested

99.999% Availability
How FUJITSU secures Carrier Grade

- 3000 UEs / 1 Cell
- 48 Cells
- Major software update every 6 months

C-BBU (*)

- 3000 UEs / 1 Cell
- 48 Cells
- Major software update every 6 months

(*) Centralized Base Band Unit

Deliver

many human resources
many department
many development rules
many gate of quality check

Software
System Test
Radio Test
Hardware
Quality control
Firmware
Kano Model

What quality do you want for OAI?

- **Attractive Quality**: Even if not implemented, it’s OK. But once implemented, the customer becomes delighted.

- **One-dimensional Quality**: The more you have, the more the customer gets satisfied.

- **Must-be Quality**: Even if fully implemented, the customer’s reaction is neutral. But if not implemented, the customer gets really disappointed.

https://ja.wikipedia.org/wiki/%E7%8B%A9%E9%87%8E%E7%B4%80%E6%98%AD
What is the state that software should be?

- The source code is always in an easy-to-understand state

What should we do to secure this state?
Approach of Fujitsu on OAI

- SArF(*) : Utilization of software metrics tools
- Simulation testing

(*) Reference information at the end of presentation
SArF : Software Architecture Finder

**Feature**

- Software clustering based on dependency graph
- City map-like visualization of the detected clusters: SArF Map
- A city block corresponds to a detected software cluster
Develop Branch_October, 23rd 2017

GTP / PDCP / RLC / MAC / SCD are mixed up

MAC / SCD are separated close to PHY building group

GTP/PDCP/RLC are separated

RU-RAU Split Branch_October, 23rd 2017

The architecture is getting better
Yellow buildings refer to the same data, tables → This file is necessary to be refactored?
The building height can be set by various metrics which helps you check software visually.
Simulator (Layer simulator)

- Improvement of layer simulator

**l3sim**

- MME/UE-stub
- MME-S1AP
- UE-RRC

**l2dlsim**

- eNB
- PDCP
- RLC

**l2ulsim**

- UE
- PDCP
- RLC

**SCDsim**

- Command: eNB/UE state generation
- Command: dlsch_ulsch_scheduler
- Scheduling result

guarantee for each function properly
Simulation (OAI Sim)

- Improvement of OAI simulator

Extension to 100UEs

 guaranty with OAI sim
What to do from now

- **Process**
  - Waterfall → Agile

- **Quality**
  - Many gate of quality check
    → Continuous Integration, Auto Test, Simulation Test

- **Development**
  → Commercially use as Private LTE
Fujitsu’s software develop flow

Development Process

Sprint planning

design

implementation & coding

Sim1 & CT testing

Sim2 & Machine testing

Next Sprint

SArF

REDMINE

GitLab

Jenkins

https://gitlab.eurecom.fr/

Layer simulator

Code coverage 100%

Input

Layer 1

Output

Input

Layer 2

Output

Input

Layer 3

Output

Code Tested by GDB, eclipse etc.
How is OAI growing up??
Development is ongoing at the same pace

The pace of development is being maintained for the last year.

- 2017 Jan: 199
- 2017 Feb: 216
- 2017 Mar: 319
- 2017 Apr: 128
- 2017 May: 153
- 2017 Jun: 202
- 2017 Jul: 100
- 2017 Aug: 165
- 2017 Sep: 93

From January 1st to October 25th, 2017
OAI Commit Ranking

openair5g (UE/eNB) – all branches Top 10

From January 1st to October 25th, 2017

50% commit from EURECOM

More diversity preferred?

#1 Cedric Roux
EURECOM

#2 Raymond Knopp
EURECOM

#3 Florian Kaltenberger
EURECOM

#4 M.K
b<>com

#5 N.H
Gmail

#6 G.C
Gmail

#7 F.L
b<>com

#8 Elena Lukashova
EURECOM

#9 Michele Paffetti
EURECOM (UniBo)

#10 Haithem Bilel
TCL
shaping tomorrow with you
References

(*)SArF